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## Grower Surveys of Resistance Management Concerns, Knowledge, and Implementation

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A Northeast Sustainable Agriculture Research and Education (NE-SARE) Professional Development Program grant supported work to unify educational efforts for Resistance Management (RM). The overall aim was to develop a core of educational materials and programs that would be presented by University Extension personnel to Northeast specialty crop growers. Several activities preceded the outreach to the grower community: presentation of a 4-part webinar series on general, fungicide, insecticide and herbicide resistance, the development of a Core Module (a slide presentation based on information presented at the webinars) and the production of a video presentation of the Core Module. Milestones within the grant included the planning and execution of multiple workshops, utilizing the educational products and distribution of surveys to document changes in grower knowledge and behavior, such as anticipated implementation of resistance management (RM). This article summarizes survey results from three Extension meetings for cranberry growers (2017-2018) and five 2017 meetings for other fruit and vegetable growers (NY and PA).

### *Massachusetts cranberry growers*

The UMass Cranberry Station holds an annual Management Update Meeting (MUM) and an annual Pesticide Safety Meeting (PSM) for Massachusetts cranberry growers. During the MUM meetings held on January 18, 2017 (Wareham, MA attended by 241 cranberry growers) and January 18, 2018 (Plymouth, MA attended by 196 cranberry growers), and the 2017 PSM (Wareham, MA attended by 82 growers), growers listened to a 20-minute presentation about RM that was based on the Core Module but tailored for the cranberry industry. At each meeting, surveys were distributed: a short survey to rate the presentations for the meeting were distributed at all three meetings, and a longer comprehensive survey about different topics presented at the meeting was distributed at the MUM meetings including a portion of the questions that addressed RM.

In the short (overall) surveys, cranberry growers rated the impact of the presentations on their knowledge and potential for implementation. When asked to evaluate the RM presentation at the 2017 MUM, 48% said it “gave me new info”, 35% said “reinforced what I already knew”, 15% said “gave me info I will use on my farm”, and only 0.8% said “nothing new presented” (n=130; 54% response rate). When asked to evaluate the RM presentation at the 2018 MUM, 46% said it “gave me new info”, 39% said “reinforced what I already knew”, 26% said “gave me info I will use on my farm”, and only 2% said “nothing new presented” (n=111; 57 % response rate). Although the meetings were attended by many of the same individuals in 2017 and 2018, and the same RM information was presented both years, many growers (46%) still reported they got new info in 2018 and more people said they would use the info they learned on their farms (15% in 2017 rose to 26% in 2018), demonstrating a value in repeated education efforts. All growers evaluated the RM presentation at the 2017 PSM as “excellent”

(67%) or “good” (33%), while 0% rated it “poor” or “fair” (n=64). When asked how the presentation increased their knowledge of RM, 44% of growers said “very much”, 54% said “somewhat”, while 1.6% said “not at all” (n=63). When asked if they would use the information received on their farms, 56% said “very much”, 44% said “somewhat”, and 0% said “not at all”.

The comprehensive survey distributed at the 2017 MUM asked more detailed questions about grower concerns regarding resistance and RM practices. Completed surveys were returned from 115 growers (48% response rate). When asked to rate their knowledge of RM before hearing the presentation, only 1% said they had no knowledge and 6% said little knowledge (n=97). Most growers felt they had a fair (42%) or good (44%) knowledge about RM, while 6% said they had an excellent understanding. When asked about their level of concern for issues related to RM, most growers were concerned or very concerned about the about the possible implications of resistance in regards to the queried topics. The topic of that had the most growers “very concerned” was the disappearance of effective pesticides due to resistance (Table 1).

*Table 1. Cranberry growers’ 2017 self-reported level of concern for possible problems created by pesticide resistance.*

**How concerned are you about:**

	Marginally	Somewhat concerned	Concerned	Very concerned
Appearance of herbicide resistant “super weeds” (n=98)	6.1%	26%	42%	26%
Disappearance of effective pesticides due to resistance problems (n=99)	1.0%	14%	39%	<b>46%</b>
Increased pesticide use on farm due to resistance problems (n=99)	5.1%	28%	30%	36%
Increased pesticides in the environment due to resistance problems (n=98)	7.1%	26%	38%	29%

Growers were asked about their likelihood of adopting certain practices relating to RM on their farms. In agreement with overall growers’ perception of having an understanding of RM, the vast majority (67%) reported that they already rotate pesticides based on modes of action (MOA) (Table 2). Most growers were either very likely or somewhat likely to increase the number of MOA per application, and not likely to decrease the number of MOA per application. When asked about the likelihood of increasing or decreasing their application rate of pesticides, the most common answer was “not likely” for each practice. More than half of growers were already integrating non-chemical controls or very likely to adopt the practice.

Table 2. Cranberry growers' 2017 self-reported likelihood to adopt RM practices on their farms.

**How likely are you to adopt the following practices:**

	Already practice	Very Likely	Somewhat Likely	Not Likely	Not sure
Rotate pesticides based on modes of action (MOA) (n=96)	<b>67%</b>	26%	6%	0%	1%
Increase number of MOA per application (n=90)	<b>13%</b>	<b>40%</b>	29%	11%	7%
Decrease number of MOA per application (n=85)	2%	9%	19%	<b>53%</b>	17%
Increased non-chemical controls (e.g., late water, hand weeding, etc.) (n=93)	<b>37%</b>	<b>20%</b>	32%	7%	4%

In the 2018 comprehensive survey, when growers were asked about changes in their understanding of RM based on extension education efforts over the last two years, 28% reported that their understanding increased a lot, 59% said it increased somewhat, and 8% said it stayed the same (n=95). Growers were also asked what behaviors they adopted based on concerns about RM (see Fig. 1). The majority reported that they rotated pesticides more often and consulted the RM chapter of the Cranberry Chart Book, a publication by the UMass Cranberry Station with information about pesticides and grower practices. Nearly half said they consulted industry personnel (e.g., agricultural sales representatives) and increased their IPM scouting efforts.

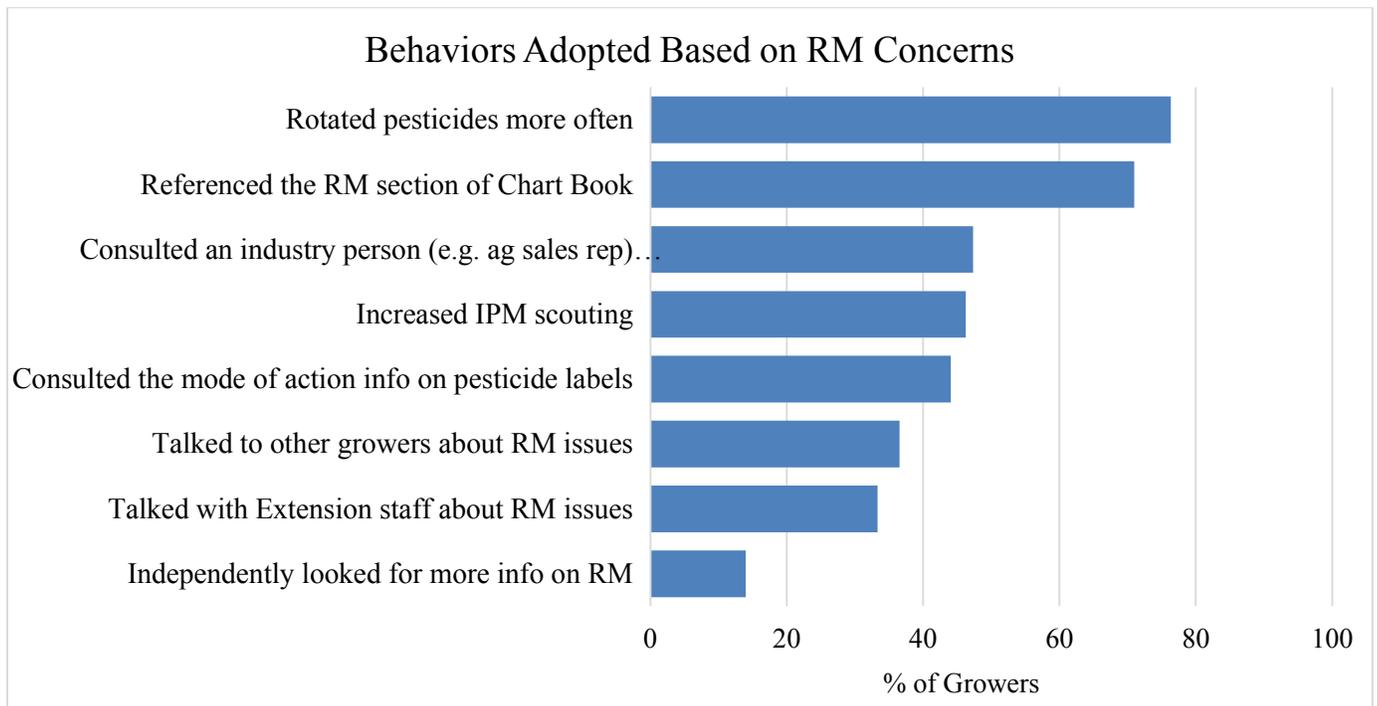


Figure 1. Behaviors reported as adopted by cranberry growers based on concerns about RM in a 2018 survey (n=93).

*New York and Pennsylvania vegetable and fruit growers*

Specialty crop vegetable and fruit growers were presented with information about RM by Extension educators who participated in the “Unifying Resistance Management Education” webinar series. The five meetings were: the Tri-County Vegetable Growers Winter Meeting in Cumberland, PA on January 18, 2017 (PA Veg), the Vegetable Grower meeting in Whallonsbury NY on March 31, 2017 (NY Veg), the Tree Fruit Grower meeting in Lake George on February 13, 2017 (LG TrFru), the Tree Fruit Grower meeting in Kingston, NY on February 15, 2017 (NY TrFru), and a Grape Grower meeting in Lake George on March 9, 2017 (LG Grp). These growers were surveyed before the RM presentations. When asked about their previous knowledge of RM before listening to the presentation, most growers from all groups reported that had a “good” or “fair” understanding, with few considering their knowledge “excellent”. For three of the groups, some individuals reported having no previous knowledge of RM (Table 3).

*Table 3. Self-reported level of knowledge about RM prior to hearing a presentation at one of five specialty crop meetings held at various Northeastern locations in 2017. TrFru=tree fruit, Grp=grape, and Veg=vegetable*

	Excellent	Good	Fair	Very Little	None
PA Veg (n=30)	0%	46%	47%	10%	0%
NY Veg (n=14)	14%	50%	29%	0%	7%
LG TrFru (n=10)	0%	40%	40%	10%	10%
NY TrFru (n=8)	13%	63%	13%	13%	0%
LG Grp (n=18)	17%	28%	28%	22%	6%

Attendees at the five different fruit and vegetable Extension education meetings answered survey questions after listening to presentations about RM. According to the responses given, all growers at four meetings felt that the presentation either gave them new info or reinforced what they already knew, with some growers at the NY TrFru meeting reporting “nothing new presented” (Table 4).

*Table 4. Grower evaluation of the information RM information presented at the meeting they attended, held at various Northeastern locations in 2017. TrFru=tree fruit, Grp=grape, and Veg=vegetable.*

	Gave new info	Reinforced what they already knew	Nothing new presented
PA Veg (n=30)	39%	61%	0%
NY Veg (n=14)	77%	23%	0%
LG TrFru (n=10)	44%	56%	0%
NY TrFru (n=8)	38%	38%	25%
LG Grp (n=18)	61%	39%	0%

Table 5. Growers' self-reported level of concern for possible problems created by pesticide resistance at various Northeastern fruit and vegetable meetings in 2017. TrFru=tree fruit, Grp=grape, and Veg=vegetable.

Appearance of herbicide resistant "super weeds"

	Marginally	Somewhat concerned	Concerned	Very concerned
PA Fruit and Veg (n=30)	10%	27%	30%	33%
NY Veg (n=14)	43%	21%	29%	7%
LG TrFru (n=10)	11%	22%	56%	11%
NY TrFru (n=8)	0%	38%	13%	50%
LG Grp (n=18)	28%	33%	28%	11%

The disappearance of effective pesticides due to resistance problems

	Marginally	Somewhat concerned	Concerned	Very concerned
PA Fruit and Veg (n=30)	3%	17%	47%	33%
NY Veg (n=14)	14%	21%	29%	36%
LG TrFru (n=10)	0%	38%	25%	38%
NY TrFru (n=8)	13%	25%	25%	38%
LG Grp (n=18)	6%	28%	50%	17%

Increased pesticide usage on your farm due to resistance problems

	Marginally	Somewhat concerned	Concerned	Very concerned
PA Fruit and Veg (n=30)	13%	13%	47%	27%
NY Veg (n=14)	29%	29%	36%	7%
LG TrFru (n=10)	0%	25%	50%	25%
NY TrFru (n=8)	38%	0%	25%	38%
LG Grp (n=18)	11%	28%	39%	22%

Increased pesticides in the environment due to resistance problems

	Marginally	Somewhat concerned	Concerned	Very concerned
PA Fruit and Veg (n=30)	7%	13%	57%	23%
NY Veg (n=14)	7%	14%	57%	21%
LG TrFru (n=10)	0%	25%	50%	25%
NY TrFru (n=8)	25%	0%	13%	63%
LG Grp (n=18)	17%	17%	39%	28%

When growers were asked about their concerns regarding possible problems that can be created by the development of pesticide resistance, the answers varied by group (Table 5). The majority of tree fruit growers attending the meetings reported they were “concerned” or “very concerned” about the appearance of herbicide resistant weeds, while vegetable and grape growers expressed less concern about this issue, reporting they were only “marginally” or “somewhat” concerned. The majority of all growers reported they were “concerned” or “very concerned” about the disappearance of effective pesticides. Most growers were “concerned” or “very concerned” about increased pesticide use on their farms except for growers at the NY Veg meeting who reported less concern about this issue. All growers reported they were “concerned” or “very concerned” about increased pesticides in the environment.

Growers were asked about their likeliness to adopt certain practices based on knowledge about RM. For all groups except LG Grp, the majority of growers reported that they already rotate pesticide based on MOA (Table 6). For growers who did not already rotate pesticides based on MOA, the majority reported they were likely or somewhat likely to adopt the practice.

*Table 6. Vegetable and fruit growers self-reported likelihood to adopt RM practices on their farms, 2017.*

Rotate pesticides based on modes of action (MOA)	Already practice	Very Likely	Somewhat Likely	Not Likely	Not relevant for my crop
PA Fruit and Veg (n=30)	77%	10%	13%	0%	0%
NY Veg (n=14)	50%	36%	0%	0%	14%
LG TrFru (n=10)	78%	0%	22%	0%	0%
NY TrFru (n=8)	50%	50%	0%	0%	0%
LG Grp (n=18)	33%	44%	17%	0%	6%

### *Overall Trends*

Using the educational materials and products developed under this NE-SARE grant had a positive impact on the promotion of RM and MOA knowledge as well as implementation of RM techniques among specialty crop growers in the Northeast. Most specialty crop growers self-reported that their RM knowledge was good but indicated that attendance at the educational workshops was beneficial. Hearing the material increased their general knowledge base about RM and MOA and/or increased the likelihood that they would implement chemical rotations more often, reference Extension material about RM, and use nonchemical controls when appropriate (behavioral changes).

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